

**SECTION 050525**  
**STRUCTURAL WELDING**

**PART 1 – GENERAL**

101. EXTENT
- 101.1 The CONTRACTOR'S structural welding shall conform to the requirements of this Section and to the requirements indicated on the design drawings.
- 101.2 Materials and installation for welding of structural steel shall conform to the requirements of this Section.
- 101.3 The CONTRACTOR'S welding shall confirm to the requirements of this section, AWS D1.1 Structural Welding Code – Steel and AWS D1.3 Structural Welding Code – Sheet Steel, as applicable.
- 101.4 The CONTRACTOR'S work shall include, but not be limited to, the following:
- a. Preparation and qualification of welding procedure specifications (WPS) and Procedures Qualification Records (PQR). The CONTRACTOR shall use AWS pre-qualified weld procedures whenever possible. If for a particular application there is no AWS pre-qualified weld procedure, then the CONTRACTOR shall prepare and qualify the new weld procedure in accordance with the requirements of Article 104.
  - b. Certification of Welders
  - c. Welding of metals to each other and to other substrates.
  - d. Inspection and testing of welds.
- 101.5 The methods, conditions, material and products specified herein apply to Work whether performed in the shop or in the field and by the CONTRACTOR's own forces or its subcontractors.
- 101.6 Welding work covered by ASME (except as noted in Paragraph 101.6 of this section), API, AWWA and AWS D9.1 specifications are not covered herein.
- 101.7 ASME Section IX qualified procedures may be used in lieu of AWS D1.6 welding procedures for stainless clad or solid stainless steel plates. If ASME Section IX is used to qualify welding procedures, welders and welding operators, all other requirements of AWS D1.1 or AWS D1.6 such as workmanship, visual inspection and technique are still applicable.
102. REFERENCE DOCUMENTS
- 102.1 Related standard specifications are referenced, but are not limited to, the documents indicated in this Section. The Work performed by the CONTRACTOR shall comply with the referenced and applicable requirements of these documents, in addition to federal, state or local codes having jurisdiction.

050525-1



Nebraska Public Power District

*Always there when you need us*

GERALD GENTLEMAN STATION UNITS 1&2

**FLUE GAS DESULFURIZATION SYSTEMS**



Specification G-5301  
Issue: Client Comments, Rev. 2  
December 31, 2009  
Project No. 12194-004

- 102.2 References to these documents shall be to the issue date as adopted in IBC 2006. If the document is not referenced in IBC 2006, then the reference is to the latest issue date of the document together with the latest additions, addenda, amendments, supplements, etc. in effect on the date of contract award.
- 102.3 Unless otherwise indicated, references to the sponsoring agencies will be made in accordance with the abbreviations indicated.
- 102.4 AISC – American Institute of Steel Construction:
- a. 360 – Specification for Structural Steel Buildings
  - b. 303 – Code of Standard Practice for Steel Buildings and Bridges
  - c. 325 – Manual of Steel Construction, 13<sup>th</sup> Edition
  - d. 341 – Seismic Provisions for Structural Steel Buildings
- 102.5 AISI – American Iron and Steel Institute: By material type noted.
- 102.6 ANSI – American National Standards Institute:
- ANSI/ASCE Z49.1 – Safety in Welding and Cutting
- 102.7 ASTM – American Society for Testing and Materials by material noted and the following:
- a. E 94 – Guide for Radiographic Testing
  - b. E 164 – Practice for Ultrasonic Contact Examination of Weldments
  - c. E 165 – Practice for Liquid Penetrant Inspection Method
  - d. E 709 – Practice for Magnetic Particle Examination
- 102.8 AWS – American Welding Society:
- a. A2.4 – Standard Symbols for Welding Brazing and Nondestructive Examination
  - b. A3.0 – Welding Terms and Definitions
  - c. A5.1 to A5.30 – Specifications for Welding Electrodes
  - d. D1.1 – Structural Welding Code – Steel
  - e. D1.3 – Structural Welding Code – Sheet Steel (applicable when the thickness of one of the connected parts is less than 0.18 inch)
  - f. D1.6 – Structural Welding Code – Stainless Steel

050525-2



Nebraska Public Power District

*Always there when you need us*

GERALD GENTLEMAN STATION UNITS 1&2  
FLUE GAS DESULFURIZATION SYSTEMS



Specification G-5301  
Issue: Client Comments, Rev. 2  
December 31, 2009  
Project No. 12194-004

103. SUBMITTALS

- 103.1 Submit the following documents in accordance with Section I, CONTRACTOR Drawing and Data Requirements.
- 103.2 Submit two copies of qualification certificates (including requalification, if any), test reports and certificates as approved by an independent testing agency for each welder and welding machine operator.
- 103.3 Submit two copies of the proposed welding procedures in accordance with the requirements of Article 104 of this Section.
- 103.4 Welding shall not be performed for the Work in the shop or the field until the welder qualification certificates and welding procedures are accepted by the DISTRICT.
- 103.5 Welding Electrodes:
- a. Welding Material Certificates of Conformance (COC) or Certified Material Test Reports (CMTRs) for the welding electrodes shall be submitted to the DISTRICT at the time of delivery of the material to the Project Site.
  - b. Submit procedures for storage and handling of electrodes.
- 103.6 Submit copies of CONTRACTOR's welding inspection and examination records prepared in accordance with Article 305 of this Section.
- 103.7 Submit welding inspector's AWS Certification.
- 103.8 Submit non-destructive testing (NDT) procedures.

104. WELDING PROCEDURES

- 104.1 The CONTRACTOR shall submit both prequalified and qualified Welding Procedure Specifications (WPS) to the DISTRICT for review. Qualified WPS shall include the Procedure Qualification Record (PQR). Welding procedures shall be qualified in accordance with applicable AWS requirements.
- 104.2 The CONTRACTOR shall submit qualified WPS for all materials that are not recognized as prequalified base materials by AWS D1.1. Qualified WPS shall include all combinations of non-prequalified base metals: welded to itself, to a dissimilar non-prequalified base metal, and to a qualified base metal. Non-prequalified base metals include, but are not limited to: ASTM A387, Grade 11, Class 2 and ASTM A387, Grade 22, Class 2 and ASTM A335, Grade P11, and Grade P22 and ASTM A240 stainless clad steel on ASTM A36 backing plate conforming to A264.
- 104.3 The WPS shall specify, as a minimum, all of the applicable essential variables as identified by AWS D1.1 or AWS D1.3 including procedure for preheating base metals, minimum preheat and interpass temperatures and as specified in this Section.
- 104.4 Where required by the contract drawings or specifications, welded assemblies shall be stress relieved by heat treating. Final machining after stress relieving shall be considered when needed

050525-3

to maintain dimensional tolerances. As a good industry practice, Post Weld Heat Treatment (PWHT) should be considered for Seismic Class 1 structural steel butt, tee or corner welds with a weld thickness greater than 1-1/2 inches. Other considerations for PWHT are as follows:

- a. PWHT shall be performed when required by the applicable WPS.
  - b. PWHT is to be performed in accordance with the requirements of AWS D1.1.
  - c. The requirements for PWHT are based on the nominal thickness of the material being welded. Nominal thickness is the thickness of the weld, or the thinner of the sections being joined, which is least. For fillet welds, the nominal thickness is the throat thickness, not the leg length. For partial penetration and material repair welds, the nominal thickness is the depth of the weld groove or preparation.
  - d. PWHT is not recommended for weldments of A514, A517, A709 Grades 100 and 100W, and A710 steels.
- 104.5 Welding shall not be performed when the ambient temperature is lower than 0 degrees Fahrenheit.
- 104.6 When the ambient temperature is at or below 32°F and no other minimum preheat or interpass temperatures are specified in the WPS, preheat base metal to at least 70°F before tack welding or welding.
- 104.7 For groove-weld joints with plates greater than 2 inch thick, the material shall have a minimum preheat as specified within Table 3-2 of AWS D1-1.
- 104.8 For combinations of base metals with different thickness, the minimum preheat and interpass temperature shall be based on the thickest part of the base metal being welded.
- 104.9 For combinations of base metals to be welded, the minimum preheat and interpass temperature shall be based on the highest minimum preheat.
- 104.10 Joints requiring preheat and subsequent minimum interpass temperature shall be uniformly heated prior to and maintained during the welding operation for a minimum distance of 5 times the thickness of the thickest welded part, but not less than 3 inches in all directions from the point of welding.
- 104.11 The preheat and interpass temperatures shall be checked by the CONTRACTOR just prior to welding by the use of contact pyrometers, temperature indicating crayons or other suitable means.
- 104.12 The welding procedures shall include the following:
- a. Selection of welding processes, equipment and material.
  - b. Personnel control and quality control of workmanship.
  - c. The controls for welding inspections and examinations shall be specified and maintained.
  - d. Weld joint details and tolerances.
  - e. Weld profiles and weld sizes.

050525-4



Nebraska Public Power District

*Always there when you need us*

GERALD GENTLEMAN STATION UNITS 1&2

**FLUE GAS DESULFURIZATION SYSTEMS**



Specification G-5301  
Issue: Client Comments, Rev. 2  
December 31, 2009  
Project No. 12194-004

- f. Size, classification and material specification for electrodes proposed.
- g. The method and types of groove and edge preparation shall be specified.
- h. The methods and/or sequence of welding to avoid distortion and to minimize residual shrinkage stresses shall be specified, if applicable.
- i. Number and travel speed of passes or melting rate, where applicable, for each weld.
- j. Procedures for PWHT, preheating base metals and the minimum preheat and interpass temperatures required by AWS D1.1 or the applicable ASME Construction Code Section.
- k. Dimensions and spacing of plug and slot welds.
- l. The gas type and flow rate shall be specified for shielding, trailing or inert purging.
- 104.13 Provide procedures for storage and handling of electrodes in accordance with AWS D1.1.
- 104.14 Welders, welding operators and NDT personnel shall be certified by independent testing agencies, of recognized standing, in accordance with SNT-TC-1A-2001, as a minimum Level 2, or equivalent acceptable to the DISTRICT. Such certifications have been validated within the previous 6 months per AWS D1.1 prior to performing the Work.
- 105. QUALITY ASSURANCE
- 105.1 The CONTRACTOR is responsible for the quality work covered under this contract. Any activities that do not meet the requirements of this contract shall require correction either by repair or replacement at the DISTRICT'S option. The DISTRICT will make the sole determination, with all associated costs to be that of the CONTRACTOR.
- 105.2 Inspections, examinations and tests that may be performed by the DISTRICT do not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures in compliance with specified requirements. The DISTRICT reserves the right, at any time before final acceptance to reject material not complying with specified requirements.
- 105.3 Welding fabrication errors shall be rectified at CONTRACTOR's expense. Promptly remove non-complying material and fabricated components and replace with complying material and fabrications.
- 105.4 Qualify welding procedures in accordance with applicable AWS procedures.
- 105.5 Qualify welders and welding operators in accordance with applicable AWS procedures.
- 105.6 Provide certification that welders and welding operators to be employed for the Work have satisfactorily passed applicable AWS qualification tests.
- 105.7 CONTRACTOR shall be responsible for the supervision of welder and welding operator qualification and the certification of the test documents. Welders and welding operators shall be tested by an independent testing agency, within the previous six months, in accordance with AWS D1.1 or AWS D1.3, as applicable. Agencies for testing welders and welding operators shall be of recognized standing. Costs in connection with this certification shall be borne by the

050525-5



Nebraska Public Power District

*Always there when you need us*

GERALD GENTLEMAN STATION UNITS 1&2

FLUE GAS DESULFURIZATION SYSTEMS



Specification G-5301  
Issue: Client Comments, Rev. 2  
December 31, 2009  
Project No. 12194-004

CONTRACTOR. Independent testing agencies are not responsible for certification of welders and welding operators.

105.8 If recertification of welders is required, retesting will be CONTRACTOR's responsibility and at its expense.

105.9 Provide procedures for storage and handling of electrodes in accordance with the manufacturer's recommendations.

## **PART 2 – PRODUCTS**

### **201. WELDING ELECTRODES**

201.1 All electrodes shall conform to AWS A5.1 through A5.30 as applicable.

201.2 Electrodes for all structural steel, miscellaneous metal, and gallery Work shall be E70XX with a minimum Charpy V-Notch toughness of 20 ft-lbs. at -20° Fahrenheit. The process consumables for weld metal, tack welds, root pass and subsequent passes deposited in a joint shall be compatible to assure notch-tough composite weld metal.

201.3 Electrodes shall also meet the requirements of AISC 341 for structures located in Seismic Category D or higher.

201.4 For steels not covered by Table 4.1 of AWS D1.1 and this Section, the CONTRACTOR shall submit proposed electrodes for acceptance. Notification shall be made prior to the start of welding.

## **PART 3 – EXECUTION**

### **301. GENERAL**

301.1 Welding shall conform to the Workmanship Section of AWS D1.1 or AWS D1.3, as applicable, unless otherwise indicated on the Design Drawings.

301.2 Comply with AWS D1.1 or AWS D1.3, as applicable, for procedures, appearance, and quality of welds and for methods used in correcting welding Work.

301.3 Steel reinforcing bars, nuts and bolts, and carbon or alloy steels containing more than 0.35 percent carbon shall not be welded.

### **302. SPECIFIC WELDING REQUIREMENTS**

302.1 Fillet welds across flanges of any steel member and any undercutting greater than 0.01 inch deep or damage that will reduce the flange area is not permitted.

302.2 All groove welds shall be complete penetration welds unless noted otherwise.

302.3 Any coating containing zinc or cadmium, on the areas to be welded, shall be removed prior to welding.

050525-6

G-5301\_050525\_STRU\_WELDING  
File No. 7.01

General Rev. 0

NPPDRH114\_0003197  
ED\_005798\_00000437-00006



Nebraska Public Power District

*Always there when you need us*

GERALD GENTLEMAN STATION UNITS 1&2

FLUE GAS DESULFURIZATION SYSTEMS



Specification G-5301  
Issue: Client Comments, Rev. 2  
December 31, 2009  
Project No. 12194-004

- 302.4 Complete penetration groove welds in girder plates shall be made before fitting and assembly into the girder. These welds shall have smooth transitions between offset surfaces, as specified by AWS D1.1.
- 302.5 The technique employed for welding shall be carefully controlled to minimize shrinkage stresses and distortion.
- 302.6 Tack welds shall be installed by certified welders.
- 302.7 Surfaces and edges to be shop or field welded shall be prepared per AWS D1.1.
- 302.8 Built-up sections may vary from straightness within the tolerances allowed for wide-flange shapes by ASTM A6, except that the tolerance on deviation from straightness of compression members is 1/1000 of the axial length between points which are to be laterally supported. Completed members should be free from twists, bends, and open joints. Noncompliance with the above criteria as well as sharp kinks or bends are cause for rejection of material.
- 302.9 The use of oversized welds or filling the joints with non-approved material to overcome poor fit-up is not permitted. Joints shall conform to the fit-up requirements of AWS.
- 302.10 Fuel gas, Electroslag, Electrogas, Flux Core-Arc (without external gas shielding) and Braze welding processes are prohibited. Gas Metal-Arc welding (short circuiting transfer) is permitted only on materials under 1/4 inch with prior written approval from the DISTRICT.
- 302.11 Inert gas metal-arc welding using consumable base wire electrodes and direct current reverse polarity may be used with prior written approval from the DISTRICT. Request for approval shall include type of electrode and type of shield inert gas proposed by CONTRACTOR.
- 302.12 All welding to existing structural steel that is ASTM A7 or ASTM A9 material shall be in accordance with the following additional requirements:
- Conform to the AWS requirements for welding of Group III steels.
  - Use shielded metal arc welding (SMAW) with low hydrogen electrodes, or use an inherently low hydrogen process such as submerged arc welding (SAW), gas tungsten arc welding (GTAW), or flux cored welding (FCAW).
  - Provide the following minimum preheat:

<u>Steel Element Thickness</u>	<u>Minimum Preheat Temperature</u>
Up to 3/4"	50°F
Over 3/4" through 1-1/2"	150°F
Over 1-1/2" through 2-1/2"	225°F
Over 2-1/2"	300°F
  - Perform magnetic particle or liquid penetrant examination of all welds.

050525-7



Nebraska Public Power District

*Always there when you need us*

GERALD GENTLEMAN STATION UNITS 1&2

FLUE GAS DESULFURIZATION SYSTEMS



Specification G-5301  
Issue: Client Comments, Rev. 2  
December 31, 2009  
Project No. 12194-004

302.13 For carbon steel that is galvanized, the CONTRACTOR shall take steps to minimize member distortion by avoiding over-welding, use of balancing welds around neutral axis, use of symmetric member sections, proper pickup and laydown and other fabrications following the guidelines of Hot Dip Galvanizing Association.

302.14 To facilitate galvanizing, the cleanness of welded areas is important. Thus, the weld electrode shall be uncoated wherever possible, or through removal of welding flux residues is required if a coated electrode is used. Submerged arc weld (SAW) shall be used for heavy weldment. Welding rods with high silica levels should not be used.

### 303. INSPECTION BY THE DISTRICT

303.1 The DISTRICT may, during the course of the Work, inspect the various phases of Work performed by the CONTRACTOR, for compliance with the Contract Documents which includes the Design Drawings. The DISTRICT reserves the right to approve the facilities to be used for inspections and examinations.

303.2 The DISTRICT's inspection will not relieve the CONTRACTOR of its obligation for inspection of the welding. The DISTRICT's testing agency will not be available for CONTRACTOR's use.

303.3 The CONTRACTOR shall provide, and pay for, access and all rigging required for the examinations performed by the DISTRICT or its Inspection Agency. CONTRACTOR shall also provide personnel to assist the DISTRICT or its Inspection Agency at no additional cost to the DISTRICT.

303.4 Acceptance of Work by the DISTRICT or its Inspection Agency shall not relieve the CONTRACTOR in any manner from full responsibility for the Work.

### 304. INSPECTION BY THE CONTRACTOR

304.1 Inspection and examination by the CONTRACTOR shall be performed by an independent testing and inspection agency in accordance with the CONTRACTOR's procedures approved by the DISTRICT. As an alternate, the CONTRACTOR's in-house Quality Control Inspectors may be used. Inspectors shall meet one of the following:

- a. Current or previous certification as an AWS Certified Welding Inspector (CWI) in accordance with the provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors".
- b. Current or previous qualification by the Canadian Welding Bureau (CWB) to the requirements of the Canadian Standard Association (CSA) Standard W178.2, "Certification of Welding Inspectors".
- c. Inspection may be performed by an engineer or technician, who, by training or experience, or both, in metals fabrication, inspection and testing, is competent to perform inspection of the Work.

304.2 Welding shall be inspected and examined in accordance with Inspection Section of AWS D1.1 and/or AWS D1.3 to the requirements specified herein.

050525-8



- 304.3 The CONTRACTOR shall be responsible for, and shall pay the costs for, the specified inspection for these welds made by the CONTRACTOR and its SubCONTRACTORS.
- 304.4 The CONTRACTOR shall maintain a complete and detailed record of the inspections and tests performed by the CONTRACTOR's independent testing and inspection agency, including reports for radiographic, ultrasonic, and magnetic particle inspection methods, in a manner approved by the DISTRICT. Copies of the records shall be submitted to the DISTRICT upon request. Records shall be certified by the CONTRACTOR's independent testing and inspection agency.
305. EXTENT AND METHOD OF EXAMINATION
- 305.1 Shop and field weld examination shall be performed in accordance with the following requirements:
- a. All welds shall be 100 percent visually examined in accordance with the Inspection Section of AWS D1.1 and/or AWD D1.3.
  - b. Complete penetration groove welds for members other than girders shall be examined 100% by both ultrasonic and magnetic particle methods. The magnetic particle examination shall be performed prior to performing the ultrasonic examination.
  - c. Plate girder flange complete penetration groove weld splices shall have 100% radiographic inspection.
  - d. Plate girder top and bottom web to flange welds shall have 10% of their total length (additive length, both sides) inspected by magnetic particle or liquid penetrant examination.
  - e. Plate girder web complete penetration groove weld splices shall have 25% of their total length inspected by random radiographic or ultrasonic examination.
  - f. Welding to existing structural steel that is ASTM A7 or ASTM A9 shall be examined in accordance with Article 302 of this Section.
- 305.2 Radiographic inspection shall conform to applicable requirements of the following specifications; where requirements differ between these specifications, the more restrictive requirements, as determined by the DISTRICT, shall apply in each case:
- a. ASTM E94
  - b. AWS D1.1
  - c. X-ray or gamma ray shall be used in radiography and the quality level shall be 2-2T per ASTM E94.
- 305.3 Ultrasonic Inspection shall conform to the applicable requirements of ASTM E164 and AWS D1.1.
- 305.4 Magnetic Particle Inspection shall conform to the applicable requirements of ASTM E709 and AWS D1.1.

050525-9



Nebraska Public Power District

*Always there when you need us*

GERALD GENTLEMAN STATION UNITS 1&2

**FLUE GAS DESULFURIZATION SYSTEMS**



Specification G-5301  
Issue: Client Comments, Rev. 2  
December 31, 2009  
Project No. 12194-004

- 305.5 Liquid penetrant inspection shall conform to the applicable requirements of ASTM E165 and AWS D1.1.
- 305.6 Records of Inspection Work: The CONTRACTOR shall maintain a complete and detailed record of the inspections and tests performed by the CONTRACTOR, including records for radiographic, ultrasonic, magnetic particle and liquid penetrant inspection methods, in a manner approved by the DISTRICT. Copies of the records shall be submitted to the DISTRICT upon request. Records shall be certified.
- 305.7 Replacement of Unacceptable Welds: Portions of welds and/or material shown by any of the specified inspection and/or testing to be unacceptable shall be cut out and/or re-welded and/or replaced and re-inspected by the same original specified inspection and/or testing until the weld is acceptable.
306. ACCEPTANCE
- 306.1 Welds meeting the acceptance standards of AWS D1.1 or AWS D1.3, as applicable, and the requirements of this Section shall be accepted.
- 306.2 Portions of welds and/or material shown by any of the specified inspection and/or testing to be unacceptable shall be cut out and/or re-welded and/or replaced and re-inspected by the same original specified inspection and/or testing until the weld is acceptable.

END OF SECTION

050525-10